Appendix D

TECHNICAL GUIDANCE

Montana and Idaho Border
Nutrient Load Agreement for Pend Oreille Lake Open Water

GOAL	Protect Pend Oreille Lake open water quality
WATERS AFFECTED	Pend Oreille Lake and Clark Fork River
TARGETS	• An area-weighted euphotic-zone average concentration of 7.3 ug/l total phosphorus for Pend Oreille Lake • Total loading to Pend Oreille Lake of 328,651 kg/yr total phosphorus • 259,500 kg/yr total phosphorus from Montana (Clark Fork River at Montana/Idaho state line) • 69,151 kg/yr total phosphorus from the Pend Oreille Lake watershed in Idaho • Greater than a 15:1 total nitrogen to total phosphorus ratio
AREA PROTECTED	Open waters of the lake (waters where the maximum depth is greater than 2.5 times water transparency as measured by Secchi depth) from the mouth of the Clark Fork River to the Long Bridge (Highway 95.) See Attachment C, Map of Pend Oreille Lake.

I. Technical Guidance Summary

In September 1999, the Tri-State Water Quality Council (Council) created a Technical Team to develop technical guidance for an agreement between the states of Montana and Idaho for establishing nutrient targets and apportioning loads to Pend Oreille Lake. The impetus for developing the targets was concern over maintaining the water quality of the open waters of Pend Oreille Lake and the need to address potential impacts from the Clark Fork River in Montana and local sources in Idaho. The Technical Team's charge was to set open water nutrient concentration targets which support the lake's designated beneficial uses, and nutrient loading targets to meet those concentrations. The team reviewed and analyzed existing data on Pend Oreille Lake and the Clark Fork to establish a solid scientific foundation for technical guidance and a proposed agreement for consideration by the two states. Team members included representatives from Montana Department of Environmental Quality (MDEQ), Idaho Division of Environmental Quality (IDEQ), the University of Idaho, and the Clark Fork Coalition. The U.S. Environmental Protection Agency (EPA) Regions 8 and 10, and the U.S. Geological Survey, participated in the team in an advisory capacity. Land & Water Consulting, contractor to the Council, provided technical expertise to the team.

Driven by citizen concerns over Pend Oreille Lake water quality, the Council, MDEQ, IDEQ and EPA concurred that development of nutrient targets at the Montana/Idaho border would be timely to help prevent pollution of the lake's open waters. Because about 90 percent of the flow and 80 percent of the loading of total phosphorus into Pend Oreille Lake comes from the Clark Fork River, targets are established for the Clark Fork River at the border to address this predominate influence on lake water quality. By establishing these targets, a major objective of the Clark Fork-Pend Oreille Watershed Management Plan is fulfilled, which is to protect Pend Oreille Lake water quality by maintaining or reducing the rate of nutrient loading from Montana's Clark Fork River, as well as reducing nutrient loading from the lake's watershed in Idaho. The targets focus on the lake's open water and do not address the nearshore, shallow areas of the lake that are influenced predominately by sources located within one mile of the shoreline. Nearshore issues will be addressed in a future document.

Establishing targets at the interstate boundary will help apportion nutrient management responsibilities between the two states for future water quality planning and implementation activities. The targets will also provide a framework for water quality management decisions related to new sources.

The goal of the nutrient loading targets is to protect open lake water quality. To reach this goal, an area-weighted euphotic zone concentration target for Pend Oreille Lake of 7.3 ug/l total phosphorus is recommended by the Technical Team. To meet this target, a total load of 328,651 kg/yr. total phosphorus is recommended to be allocated as follows:

- 259,500 kg/yr total phosphorus from Montana (Clark Fork River at Montana/Idaho state line;) and

- 69,151 kg.yr total phosphorus from the Pend Oreille Lake watershed in Idaho.

Additionally, the team recommends maintenance of a ratio greater than 15:1 total nitrogen to total phosphorus. Set as an action level, a 15:1 ratio is a desirable lower limit to avoid the occurrence of algal blooms in Pend Oreille Lake.

II. Background

A. Clark Fork-Pend Oreille Project History

In response to citizen concerns and complaints about the growing presence of algae in the Clark Fork-Pend Oreille watershed, in 1987 U.S. Congress mandated EPA to conduct a comprehensive water quality study in the three-state basin and to report study findings and recommendations to Congress. Authorized in the Clean Water Act, this study was known as the Section 525 Clark Fork-Pend Oreille Basin Water Quality Study. Regions 8 and 10 of EPA had primary federal responsibility for implementing the study, while the states of Montana, Idaho and Washington identified research objectives within their boundaries, conducted the research, wrote reports and recommended state-specific management actions to meet the basin-wide study objectives. A steering committee consisting of representatives from EPA and the three states oversaw the study and reviewed and summarized the three state plans into a document titled: Clark Fork-Pend Oreille Basin Water Quality Study: A Summary of Findings and a Management Plan. Following a series of basin-wide pubic hearings, the management plan was finalized in 1993.

The plan focuses on the control of nutrients and eutrophication in the three-state basin, and its goal is to restore and protect designated beneficial water uses basinwide. To meet the goal, the plan establishes four objectives:

1. Control nuisance algae in the Clark Fork River by reducing nutrient concentrations.
2. Protect Pend Oreille Lake water quality by maintaining or reducing current rates of nutrient loading from the Clark Fork River.
3. Reduce nearshore eutrophication in Pend Oreille Lake by reducing nutrient loading from local sources.
4. Improve Pend Oreille River water quality through macrophyte management and tributary nonpoint source controls.

The watershed management plan is being implemented by the Council, a broad-based 28-member group established by EPA and the three states in October 1993. In addition to setting policy and direction for water quality management actions, the Council oversees the efforts of various subcommittees who are working in local communities throughout the watershed to carry out priority actions from the plan. One of the top priorities in the plan is the development of nutrient targets and nutrient reduction strategies for the Clark Fork River and Pend Oreille Lake. The Council's work to meet the four management plan objectives can be summarized as follows:

Management Plan Objective 1:
Control nuisance algae in the Clark Fork River by reducing nutrient concentrations.

Work on the Clark Fork River targets began in 1994 when a Nutrient Target subcommittee was established by the Council to forge numeric targets and a workable implementation plan for meeting those targets. The process was driven by 303(d) requirements of the federal Clean Water Act and the State of Montana's responsibility under Section 303(d) to develop a TMDL. However, in 1995 the Council decided to take a voluntary approach rather than a mandatory, permitted approach. With approval from MDEQ and EPA to proceed with development of a voluntary program, the subcommittee wrestled with the complex scientific and policy issues associated with the reduction of nutrient loading. After four years of work the group completed the Clark Fork Voluntary Nutrient Reduction Program (VNRP), which was approved by EPA Region 8 in October 1998 as a functionally equivalent TMDL for the river.

The goal of the Clark Fork VNRP is to restore beneficial uses and eliminate nuisance algae growth in the river from Warm Springs Creek to the Flathead River confluence. To meet the goal, the VNRP sets numeric targets for chlorophyll-*a*, total phosphorus, and total nitrogen[1] for 200 miles of river and sets site-specific measures to meet the targets over a ten-year period. The VNRP includes commitments for specific actions to be taken by each of the four key point source dischargers (the three cities of Butte, Deer Lodge, Missoula and Smurfit-Stone Container Corporation) and calls for reductions from other point sources and key non-point sources to reach the numeric targets.

Management Plan Objective 2:
Protect Pend Oreille Lake water quality by maintaining or reducing current rates of nutrient loading from the Clark Fork River.

Having been successful in reaching consensus on goals and a strategy to significantly reduce nutrients and algae on the Clark Fork River, the Council focused its attention downstream of the VNRP to prevent pollution of Idaho's Pend Oreille Lake. Council members along with EPA and both states agreed that a nutrient loading target at the border would be instrumental in preventing increased cultural eutrophication to the lake's open water. As noted above, since about 90 percent of the flow and 80 percent of the loading of total phosphorus into Pend Oreille Lake comes from the Clark Fork River, targets are established at the border to address this predominate influence on the lake's open water. It was further agreed that targets at the border would provide the basis for a coordinated interstate management approach by apportioning responsibilities between the two states for protecting the lake. After a series of conference calls during 1999, representatives of the Council, EPA Region 8 and 10, and the states of Montana and Idaho made the decision to proceed with development of a target for the lake. A work plan was

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1 Targets for the Clark Fork mainstem are:

- 100 mg/square meter (summer mean) and 150 mg/square meter (peak) chlorophyll-*a*, at any site, for the entire Clark Fork River area of the VNRP;
- 20 ug/l total phosphorus upstream of the Reserve Street bridge at Missoula, where Cladophora is a problem and the 15:1 N:P ratio should be maintained;
- 39 ug/l total phosphorus downstream of the Reserve Street bridge at Missoula; and
- 300 ug/l total nitrogen.

developed in November 1999 and signed by MDEQ and IDEQ indicating the agencies' support of the border agreement approach. The team began its work in early 2000 and presented its technical findings and recommended targets to the Council in October 2000. At that time the team also presented a draft agreement for the states'_consideration as a possible format for describing Montana and Idaho responsibilities and roles in meeting the targets. The Council presented the Technical Guidance and agreement documents to the two states in January 2001.

Management Plan Objective 3:
Reduce nearshore eutrophication in Pend Oreille Lake by reducing nutrient loading from local sources.

Once the open lake targets of the border agreement are finalized, the Council will begin work with IDEQ and local stakeholders on a nutrient management strategy to reduce impacts from nearshore nutrient sources affecting the lake's shallow bays. (See brief discussion on nearshore issues, Page 7.)

Management Plan Objective 4:
Improve Pend Oreille River water quality through macrophyte management and tributary nonpoint source controls.

Once the lake nutrient management strategy is completed, the Council will work with IDEQ and the Washington Department of Ecology (DOE) on a coordinated approach to address issues in the Pend Oreille River in Idaho and Washington. In Washington, the Council has been participating with DOE, the Pend Oreille Conservation District, the Pend Oreille Public Utility District and other entities in local watershed planning efforts already underway in Pend Oreille County.

B. Overview of the Clark Fork-Pend Oreille Watershed

The Clark Fork-Pend Oreille watershed encompasses nearly 26,000 square miles in western Montana, northern Idaho and northeastern Washington. The Clark Fork River, Pend Oreille Lake and Pend Oreille River are among the main bodies of water in the basin. The Clark Fork River begins along the west slopes of the Continental Divide and drains much of western Montana before entering Pend Oreille Lake. The lake is the source of the Pend Oreille River, which flows into northeastern Washington. The waters then enter the Columbia River. Highly valued recreational and economic resources characterize the watershed. Timber, mining, fish, wildlife, water, rangeland and croplands support a variety of human uses, ranging from logging and agriculture to recreational fishing and boating.

Concerns about environmental problems in the basin are longstanding (EPA 1993). The two greatest concerns are pollution from heavy metals from past mining and smelting activities in the headwaters of the Clark Fork River and eutrophication problems caused by excessive nutrients.2 Eutrophication manifests itself in the Clark Fork River in Montana as nuisance levels of attached and filamentous algae that impair most designated uses of the river. In Pend Oreille Lake, increasing growths of algae and other aquatic plants in nearshore areas and public perception of decreasing water clarity are the primary water quality concerns. In Washington, the Pend Oreille River is choked with heavy growth of aquatic plants that impede boat traffic and most other uses.

C. Overview of the Pend Oreille Lake Problem Assessment

Due to uncertainties about maintaining lake water quality especially in near shore areas, Pend Oreille Lake was added to the State of Idaho's 1994 Section 303(d) list –and retained on the 1996 list—as a "threatened" waterbody. Because of this listing, IDEQ prepared a problem assessment on the lake (DEQ 1999) which included the following elements, as briefly summarized here:

1. Physical and Biological Characteristics

   Pend Oreille Lake is the largest and deepest natural lake in Idaho and is recognized throughout the Inland Northwest as an extremely valuable water resource. The surface area of the lake is 91,180 acres. Lake levels are controlled by Albeni Falls dam operated by the U. S. Army Corps of Engineers near the Idaho/Washington boundary. Eighty three percent of the lake's watershed is forested (Eastern Washington University 1991). While nearly 65 percent of the lakeshore is in National Forest, almost half of all developable land in the lake's watershed is located within one mile of the lakeshore. Development pressure predicted by population growth figures will likely be concentrated fairly close to the lake because of the location of these lands (Hoelscher *et al.* 1993).

   Pend Oreille Lake's designated uses are water supply, recreation, salmonid spawning, cold-water biota, wildlife habitat and aesthetics. The lake supports a significant sport fishery [in1991, anglers expended an estimated 465,000 hours fishing the lake (Corsi *et al.* 1998) and the world record bull trout, weighing 32 pounds, was taken from the lake in 1949] and is a main water source for many homes along its shores.

2. Pollutant Source Inventory

   Point sources: Of the four point sources (Cabinet Gorge Dam, Cabinet Gorge Fish Hatchery,

2 At the beginning of the Section 525 studies, the steering committee decided to restrict the studies to nutrients because they are the primary interstate water quality issue and affect the largest portion of the watershed. The steering committee also concurred that remedial actions on metals were already well underway through the federal Superfund program. Thus, the focus of the Council's work to reduce pollution in the watershed is on nutrients.

Clark Fork Hatchery and Kootenai-Ponderay Sewer District), only one discharges directly into the lake. The sewer district of the cities of Kootenai and Ponderay each year discharges 1,432 kg. total phosphorus and 9,929 kg. total nitrogen into Boyer Slough (Hoelscher *et al.* 1993).

Non-point sources: Non-point sources that contribute nutrients to the lake are the result of land disturbing activities such as residential development, silviculture, agriculture, grazing. Atmospheric deposition, septic tanks, and urban runoff are also sources of nutrients. The areas of highest algae growth along the lakeshore are areas of higher residential development (Falter *et al.* 1992). Phosphorus and nitrogen also enter the lake from tributary streams, most notably the Pack River, Lightning Creek and Sand Creek (Frenzel 1991b).

3. Water Quality Concerns and Status

The primary water quality concerns for the lake are: nutrients, metals, gas saturation (from Cabinet Gorge and Noxon Rapids hydroelectric dams), fisheries (Endangered Species Act listed bull trout), and Eurasian Milfoil (a non-native aquatic weed that forms dense weed beds and can severely restrict beneficial uses). Due to the water level fluctuations and shoreline development, bank erosion is severe in some areas (IDEQ 1999). The problem assessment also notes that as of 1999 none of the National Pollutant Discharge Elimination System (NPDES) permits for point sources were current, and that Idaho Water Quality Standards may not be protective of the lake from the standpoint of mixing zone requirements or cumulative effects from dischargers.

The State of Idaho Water Quality Standards include a narrative description for unacceptable levels of nutrients that states: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." The lake is afforded additional protection by being designated by the State as a Special Resource Water. Because of this designation, no new point sources are allowed and existing sources are limited to their current permit capacities. The Special Resource Water designation protects the lake from discharges that would cause a measurable reduction in ambient water quality below the applicable mixing zone.

Open lake water quality—which is predominantly influenced by the Clark Fork River—has not changed statistically since the mid-1950's (Beckwith 1989, Woods 1991a). However, Hoelscher *et al.* (1993) concluded that at the projected population growth rate, the difference between existing conditions (oligotrophic) and less desirable conditions (mesotrophic) would be reduced by approximately one half in twenty years. The population growth projected (population of 35,081 in Bonner County by 2010) by Hoelscher *et al.* (1993) was actually reached in 1998. Therefore, the growth pattern around the lake has reached the potential for being a very real threat to water quality.

4. Nearshore Water Quality Concerns

Population growth and shoreline development poses potential threats to nearshore and open lake water quality. Without nutrient management planning and implementation, excessive nutrients in the nearshore could impair the lake's aesthetic qualities, recreational uses and domestic water supplies (EPA 1993). Sources of these nutrients include residential development, roads, silviculture, septic tanks, and urban runoff. These sources will be addressed as part of the Council's future effort to meet Objective 3 of the management plan (to reduce nearshore eutrophication in the lake by reducing nutrient loading from local sources) through the development of a lake nutrient management strategy.

5. Problem Assessment Conclusions

IDEQ's problem assessment recommends de-listing of the lake and EPA approved de-listing in 2000. However, the assessment recognizes that over the long term there remains concern that water quality of the lake could be degraded. The assessment therefore supports the Council in its future efforts to develop a nutrient management strategy for the lake.

D. Overview of Upstream Issues

Upper and middle Clark Fork River:
Although heavy metals pollution in the headwaters of the Clark Fork is the most acute problem in the upper basin, nutrient pollution affects the largest portion of the basin and is the primary interstate water quality issue. Excessive nutrients in the river originate from a combination of point and nonpoint sources. Ambient concentrations of phosphorus and nitrogen have led to blooms of filamentous algae in the river above Missoula and heavy growths of slime, or diatom algae, below Missoula. Algae impair beneficial uses of the river, such as irrigation and recreation, and in large concentrations can deplete dissolved oxygen needed by fish and other aquatic organisms. The 525 study showed that excessive levels of algae caused water use impairment in up to 250 miles of the Clark Fork, to its confluence with the Flathead River. This impairment was the basis for the development of the VNRP, as described on Pages 3-4. Most of the Clark Fork River, as well as its tributaries, is classified as a B-1 waterbody, which means that the river's quality shall be maintained for all beneficial uses.

Flathead River:
The Flathead River provides a large flow of water containing low concentrations of nutrients, which dilutes Clark Fork River water. The Flathead provides a source of dilution relative to the Clark Fork by contributing 67% of the water, 33% of the total phosphorus and 47% of the total nitrogen to the Clark Fork at Cabinet Gorge (based on 1984-99 record.) The 525 study showed locally important sources of nutrient loading in the Flathead watershed. Concerns about nutrient loading to Flathead Lake are being addressed through a TMDL for the lake and its watershed. Flathead Lake serves as a nutrient sink and is largely responsible for reduced downstream nutrient concentrations. Downstream of the lake, operation of Kerr Dam on the lower Flathead

River causes fluctuating stream flows that can affect water quality and nutrient loading. Nutrient levels may also be affected by local sources in tributaries below Kerr Dam.

Lower Clark Fork River:
Below the Flathead River, the Clark Fork is characterized by very large streamflows and low nutrient concentrations. Reservoirs created by dams along the river at Noxon and Cabinet Gorge act as nutrient sinks for river nutrients, but because of rapid flushing in these reservoirs the percent of total nutrient retention is small or variable (Beak 1997.)
A review of existing data by Beak concluded that the retention of total phosphorus on an annual basis is probably on the order of 10 to 20 percent, although during low flow summer conditions retention in probably more substantial. Beak further concluded that algae in the reservoirs are probably more light-limited than nutrient-limited. Mass balance calculations based on data from 1984-1999 (MDEQ and Council) suggest that total phosphorus retention over the 16 year period was on the order of 25% (Land & Water 2000).

Control strategies for curbing nutrient loading in Montana's Clark Fork River basin are being implemented through the VNRP and the Flathead TMDL. However, new proposals could increase nutrient loading, such as a new point source discharge being proposed for a mine at Rock Creek on the lower Clark Fork which would introduce metals and nutrient pollution to the lower river and Pend Oreille Lake. The proposed mine project has not yet obtained an operating or discharge permit, however the Pend Oreille Lake targets would provide a basis for addressing this and other new sources so that water quality improvements made by nutrient control strategies in the basin are not jeopardized._

III. Existing Studies and Surveys

The first important task of the border agreement Technical Team was to research and review existing data on Pend Oreille Lake. The team assembled some of the members of the Section 525 study, including technical experts from IDEQ, MDEQ, the University of Idaho and U. S. Geological Survey, to review the study data as well as other data sources. The following discussion summarizes that review.

Public interest groups, industries and businesses, universities, local governments, and state and federal agencies have investigated the resources of Pend Oreille Lake to varying extent. Most of these efforts have been summarized by the Environmental Research Laboratory (1987), Beckwith (1989), Seifert (1989), Hoelscher (1993), and Hoelscher *et al.* (1993).

Fewer of these efforts focused on more traditional measures of water quality. Kemmerer and others visited Idaho early this century (Kemmerer *et al.* 1923; as cited in Rieman 1976). More recently, investigators have classified the pelagic, open waters of the lake as oligotrophic or nutrient poor (Stross 1954, Woods 1991a) tending toward mesotrophy or moderately nutrient enriched (Rieman 1976, Milligan *et al.* 1983, Beckwith 1989). The lake's great depth has been cited as an important factor in maintaining the oligotrophic characteristics (Stross 1954, Rieman 1976, Milligan *et al.* 1983, Watson *et al.* 1987, Woods 1991a). Comparisons with previous Pend Oreille Lake limnological data (Stross 1954, Platts 1958, Rieman 1976, Beckwith 1989) indicated no apparent changes in the trophic status (Platts 1958, Rieman 1976, Beckwith 1989, Woods 1991a). Beckwith (1989) and Woods (1991a) further reported no statistical differences in traditional measures of trophic state from the early 1950's to present. These data should be interpreted with caution because of differences in analytical methods, small sample size, and temporal and spatial variability.

Pend Oreille Lake is characterized by two distinct basins. The large, deep southern basin contains most (95%) of the lake's volume and has a mean depth of about 220 m (Woods 1991b). Water flowing into the southern basin will likely reside there in excess of ten years (Falter *et al.* 1992). The northern basin is much shallower with a mean depth of 29 m (Woods 1991b). Because of the smaller volume and the large flow of the Clark Fork River, water resides in the northern basin much less than one year (Falter *et al.* 1992).

A common feature among historical investigations was the strong influence exerted by the Clark Fork River on Pend Oreille Lake water quality (Stross 1954, Platts 1958, Rieman 1976, Beckwith 1989, Woods 1991a). This would be expected as most (90%) of the inflow to the lake is accounted for by the river (Frenzel 1991a). Studies have shown that the water quality of the open waters of the lake is influenced primarily by inflow from the Clark Fork River (Woods 1991b), while the water quality of the lake's nearshore zone is influenced to a greater extent by residential development and other local land use activities (Falter *et al.* 1992).

An often-used indicator of lake water quality is water clarity. The deeper, southern lake basin was found to be clearer than the shallower, northern part of Pend Oreille Lake (Stross 1954, Rieman 1976, Beckwith 1989, Woods 1991a). The greater clarity was attributed to the southern basin's depth and distance from the Clark Fork River. Suspended sediment in the river inflow, as well as re-suspended sediment from the lake bottom and near shore areas, were the main causes of lower water clarity along the north shore (Woods 1991a).

Nitrogen and phosphorus contribute to algae growth and either of these two nutrients can be limiting depending on their ratio. Phosphorus is the nutrient most often limiting algae and aquatic plants in the Pend Oreille Lake (Rieman 1976, Greene *et al.* 1984, Gangmark and Cummins 1987, Woods 1991a). Total phosphorus concentrations have been shown to increase from south to north (Woods 1991a). The south-to-north increase has been partially attributed to the Clark Fork River's input of suspended sediment. In nature, phosphorus is adsorbed to soil particles and enters surface waters from erosion of soils in the watershed. Nutrient concentrations were higher in the mid-1970's (Rieman 1976, U.S. Geological Survey 1976) than they were in the late 1980's and early 1990's (Woods 1991a). These comparisons need to be judged critically because of analytical methods and sample size. Beckwith (1989) further cautioned conclusions from these data as it is quite likely that average annual nutrient loads to the lake truly were higher during this period because of higher stream flows.

Although nitrogen limitation is common in the Clark Fork River (especially in late summer) Pend Oreille Lake is primarily phosphorus limited, with occasional nitrogen limitation in late summer in the north lake. (Falter, see Attachment D.) According to Falter's review of data and literature, the fact that the Clark Fork River is often nitrogen limited probably has little bearing on the limiting factor in most of the south lake or mid-lake. Algal assays in Pend Oreille Lake through the fall 1984 indicated primary phosphorus limitation with secondary limitation by nitrogen at all sites (Woods 1991a). Algal assays in the lake through summer-fall 1986 indicated primary phosphorus limitation and secondary nitrogen limitation in the north and mid-lake but exclusive phosphorus limitation in the south lake (Gangmark and Cummins 1987). As with many large lakes, the growth of algae in near shore areas of Pend Oreille Lake is attributed to nutrient enrichment from shoreline and lake nearshore sources.

Chlorophyll-*a*, the primary photosynthetic pigment of algae and aquatic plants, is a widely cited and accepted indicator of trophic state (Carlson 1977, Ryding and Rast 1989). Mean chlorophyll-*a* concentrations were low and spanned a narrow range (Woods 1991a). Allowing for differences in analytical methods, it appeared current chlorophyll-*a* concentrations (1989/1990) differed little from those measured nearly twenty years ago (U.S. Geological Survey 1976.) It has been stated Pend Oreille Lake primary productivity has been inhibited by the Clark Fork River's temperature (Platts 1958), turbidity (Rieman 1976) or a combination of the two (Stross 1954). The Environmental Research Laboratory (1987) modeled chlorophyll-*a* production using the lake average total phosphorus concentration and the conclusion was that algae production was not excessive.

Several data sources exist for establishing nutrient targets for Pend Oreille Lake and the Clark Fork River at the Montana-Idaho state line. The most temporally and spatially robust data for Pend Oreille Lake was collected during 1989 and 1990. The data is comprised of about 300 water samples taken at five lake stations (Woods 1991a). Precision of the data was analyzed with duplicate samples for quality-assurance purposes. The U.S. Geological Survey streamflow and nutrient concentration sampling below Cabinet Gorge Dam during those same years is the most rigorous for the Clark Fork River for 1989/90. The most continuous long term monitoring record began in 1984 with MDEQ's Clark Fork monitoring program that included sampling at multiple river sites, including below Cabinet Gorge dam. In 1998, MDEQ's nutrient concentration data record was continued by the Council's Monitoring Committee (Land & Water 1999). The Technical Team considered all of these data sets in establishing nutrient targets for Pend Oreille Lake.

IV. Nutrient Targets, Loading Analysis and Allocation

A. Assumptions